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## Are Options on Soybean Futures Profitable?: A Test of the Straddle Ratio Trading Strategy

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Abstract

This paper focuses on the hypothesis that seasonal factors may not be correctly incorporated into the prices of options on commodity futures. As unanticipated, supply information enters the market during the growing season, the volatility of prices may increase. The trading rule proposed in this paper attempts to capitalize on the misspecification of volatility, primarily on volatility increases during the growing season. The overall empirical results, using the data of soybean futures, indicate that the proposed "straddle ratio" strategy is a viable way of participating in agricultural commodities market even on a risk-adjusted basis.



Are Options on Soybean Futures Profitable?:  
A Test of the Straddle Ratio Trading Strategy

On October 31, 1984 the Chicago Board of Trade began trading options on soybean futures. An overview of studies on commodity futures suggests that serial dependence of futures prices may exist.<sup>1</sup> This may be due, in part, to seasonal factors which clearly exist in many agricultural commodities. This paper focuses on the hypothesis that seasonal factors may not be correctly incorporated into the prices of options on soybean futures. The seasonal factors are, of course, related to the growing and dormant seasons. In particular, as unanticipated supply information enters the market during the growing season, the volatility of prices increases, which is supported by various studies.<sup>2</sup> The trading rule proposed in this paper attempts to capitalize on the misspecification of volatility, primarily on volatility increases during the growing season. The first part of this paper outlines the logic and benefits of this trading rule. The second part describes the data and the methodology, and the third part discusses the results.

Trading Rule

The trading rule, called the "straddle ratio" (SR, hereafter) is based upon the purchase of a straddle, i.e., a put and a call with the same maturity and exercise price. The SR is simply a ratio where the numerator is the historical volatility measure and the denominator is the price of the straddle (i.e.,  $SR = V/(C+P)$ , where  $V$  is the historical volatility of futures prices, and  $C$  and  $P$  represent the call and the put price of the futures, respectively). The historical volatility

measure is represented by a range of historical prices averaged over several periods. A more detailed discussion of the determination of this range will follow, but it will be sufficient for the moment to think of the numerator as the expected price movement of soybean futures prices. Similarly, the denominator, which is the price of the straddle, represents the amount of price movement necessary in either direction to recoup the straddle cost. Therefore, if an SR of 1 results, then the expected price movement equals the straddle price and a breakeven condition occurs. If a ratio of greater than 1 occurs, the SR indicates a favorable buy condition.

Table I illustrates the underlying logic of the straddle strategy. Consider XYZ futures trading at \$6.00. One could buy a November \$6.00 call for \$.15 and a November \$6.00 put for \$.10, so that his total initial investment will be \$.25.<sup>3</sup> If the future price changes in either direction by \$.50 at the expiration of the option, his net gain given the initial cost (i.e., the straddle price) \$.25 will be \$.25. The maximum loss will take place if the futures price stays unchanged at \$6.00. If the futures price changes in either direction by the straddle price (i.e., the SR equals 1), then the net gain will be zero. Figure A shows the profit profile for the straddle as a function of the futures price at the expiration date of the option. As

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Insert Table I and Figure A about here

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such, this straddle strategy is not dependent on the direction of price movement but rather on the price volatility. This is the main advantage of the trading rule: forecasts as to the direction of

soybean futures are not necessary. If option prices imply a lower volatility than is suggested by historical measures, then both the put and call are underpriced, so that the trading rule signals the purchase of a straddle.

#### Data and Methodology

Historical data were gathered by weekly increments for soybean futures contracts of May and November for the years 1974 to 1983. Ten years of data were felt to be sufficient to capture a broad cross-section of seasonal swings. The May and November contracts were chosen because each contract began trading at the beginning of a season: growing or dormant. Table II shows the average ranges from the high to low price and the average ranges from the opening price to the high or low, whichever is greater.<sup>4</sup>

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Insert Table II about here  
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Rather than using either the high to low range or the open to high or low whichever is greater, a more reasonable and restrictive range was devised. A more restrictive range was necessary because of the implications of the above ranges. Both assume that market turns can be predicted with accuracy. Therefore, if a normal distribution of soybean prices is assumed, we can expect with roughly an 80 percent degree of confidence (based on Tchebysheff's Theorem) that the expected price movement will be at least the mean range over the period minus one standard deviation. Because of the large number of buy signals which occurred, the more restrictive range (from open to high or low) was used for testing.

Daily option prices for the May and November contracts from November 1, 1984 to July 1, 1985 were gathered and used to compute the SR. (Since we considered the call and put options with the same exercise price and expiration date for the straddle, only at-the-money options were used.) An example of the SR follows. The price of the straddle on November 1, 1984 with a May expiration date and a striking price of \$6.50 is \$.38 (for a call) plus \$.36 (for a put) or \$.74. Our historical data (from Table II) shows an average price range (O - H or L) from November through April of 173.02 cents with a standard deviation of 107.59. Therefore, our adjusted expected price range is 65.43 cents. This value is then entered into the numerator of the SR as follows:

$$SR = \frac{65.43}{74} = .88$$

This straddle is therefore overpriced based on historical data. In summary, the numerator is the adjusted historical price range and can be viewed as the minimum expected price range either up or down, necessary to break even, and the denominator is the sum of the put and call prices.

As with any investment strategy, both risk and return must be considered. The SR proposes to increase the return and reduce the risk through superior timing. In other words, if the SR is a profitable trading strategy, it would provide information that yields a superior return to a naive strategy of purchasing every available at-the-money straddle. Also, the strategy of purchasing a put and a call logically

would result in less volatility than either the purchase of just a put or a call. In the framework of Sharpe's Index, where the return is divided by the standard deviation, the straddle strategy is compared to other strategies involving soybeans futures (e.g., a call or a put alone).

### Results

Table III shows the implementation of the SR and the gross holding period return from the date of purchase to the expiration of the option<sup>6</sup> or in the case of the November contracts until the first of July when the study was completed. The gross holding period return is the total payoff of the straddle divided by the purchasing price (i.e., the straddle price) at the first trading date in the month of purchase.

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Insert Table III about here  
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In all cases in Table III, a return of 1.00 signifies a net return of zero percent. Three cases (November, December and February of the May contract) were rejected to purchase by the SR criterion. As expected, the returns on the straddles purchased in November, December and February are .4127, .5194 and .7173 representing losses of 58.73 percent, 48.06 percent and 28.27 percent, respectively. On the other hand, all SRs over 1 yield profit with the exception of the most recent buy signal (in June for the November contract). In sum, the SR appears to be a viable trading strategy.

Another interesting point of our results is the value of the SR itself. The SRs on the May contract range from .8963 to 1.1204

indicating little deviation between the historical measure of the price range (expected movement) and the price of the straddle. However, the SRs for the November contract are between 2.0084 and 2.3398 showing a wide divergence between the historical price range and the present price of the straddle. One possible explanation for this would be that the market (in its first year for soybean options) has not correctly adjusted for changes in volatility from season to season. Table IV compares the SR strategy to purchasing a call alone and a put alone in terms of the return over the period, the standard deviation of the return, and the Sharpe's index of performance.<sup>5</sup> As mentioned, in every case excepting one, the proposed straddle ratio strategy results in a profit. On a risk adjusted basis (i.e., the Sharpe's index), the SR strategy appears to outperform both buying a call alone and buying a put alone strategies in all cases.

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Insert Table IV about here  
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In conclusion, the overall results indicate that the proposed straddle ratio is a viable trading strategy even on a risk-adjusted basis. Furthermore, it does not require an estimate as to which direction the market is going. Considering that the option market for soybean futures is still in its infancy, it is premature to draw definite conclusions on whether the proposed straddle ratio is an effective timing tool. However, the straddle ratio strategy at this stage clearly appears to be an excellent way of participating in agricultural commodities markets. In particular, it is expected to perform well in widely fluctuating markets.

Footnotes

<sup>1</sup> For a review of studies on futures contracts, see Kamara, Avraham, "The Behavior of Futures Prices: A Review of Theory and Evidence," Financial Analysts Journal, July-August 1984, pp. 68-74.

<sup>2</sup> See among others, Anderson, R. W. and S. P. Danthine, "The Time Pattern of Hedging and the Volatility of Futures Prices," The Review of Economic Studies 50 (1983), pp. 249-266. See also Anderson, R. W., "The Determinants of the Volatility of Futures Prices," Columbia University CSFM working paper no. 33 (1982).

<sup>3</sup> Each option is standardized at 5000 bushels, so that the actual cost will be \$1250.

<sup>4</sup> It is interesting to note that the price range (which can be viewed as a proxy for the volatility measure of futures prices) in Table II decreases as the contract approaches its maturity. This result is consistent with other studies on the time-to-maturity effect on the volatility of futures prices. See for instance, Rutledge, D., "A Note on the Variability of Futures Prices," Review of Economics and Statistics 58, pp. 118-120 (1976), and Park, H. and S. Sears, "Estimating Stock Index Futures Volatility through the Prices of Their Options," The Journal of Futures Markets, Vol. 5, No. 2, pp. 223-237 (1985).

<sup>5</sup> The original Sharpe's index is the excess return (the return minus the risk-free rate) divided by the standard deviation. In this paper, for convenience the simple ratio of the return to the standard deviation is used for comparing the SR strategy with buying a call alone and a put alone strategies.

<sup>6</sup> The straddle purchased in January was sold on the first of February since the SR became unfavorable.

Table I

A. Option Prices on XYZ Futures

	<u>November</u>	<u>XYZ Futures Price</u>
XYZ \$6.00 call	\$.15	\$6.00
XYZ \$6.00 put	\$.10	\$6.00

B. Profit From Buying XYZ November 6.00 Straddle

<u>Futures Price at Expiration</u>	<u>Initial Value of the Straddle</u>	<u>Value of Call at Expiration</u>	<u>Value of Put at Expiration</u>	<u>Return (\$)</u>
5.50	-.25	0	.50	.25
5.75	-.25	0	.25	0
6.00	-.25	0	0	-.25
6.25	-.25	.25	0	0
6.50	-.25	.50	0	.25

Figure A

Profit Profile at Expiration From Buying  
a XYZ \$6.00 Straddle

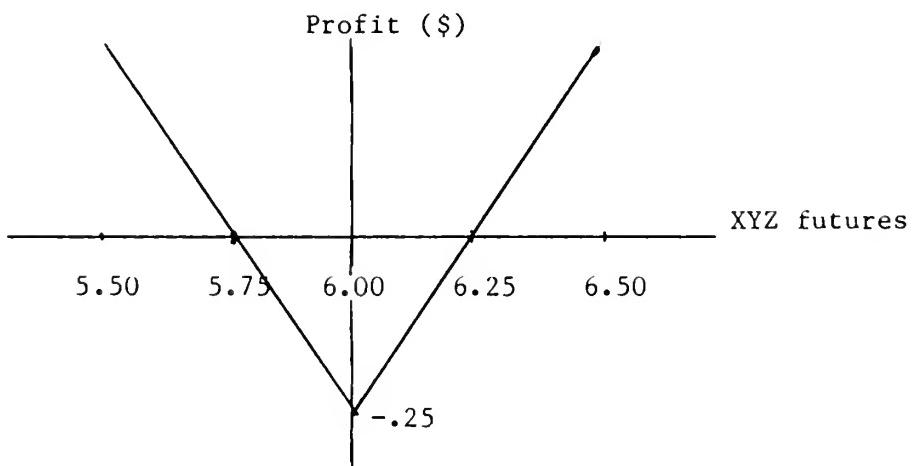


Table II  
MAY CONTRACT MEAN RANGES\* (1974-1983)

	<u>Nov.-Apr.</u>	<u>Dec.-Apr.</u>	<u>Jan.-Apr.</u>	<u>Feb.-Apr.</u>	<u>Mar.-Apr.</u>
H-L	198.85	178.55	151.15	125.92	102.90
$\sigma$	114.14	94.04	76.43	66.17	53.62

O-H or L	173.02	158.42	125.27	108.72	86.65
$\sigma$	107.59	103.69	78.28	68.69	57.52

NOVEMBER CONTRACT MEAN RANGES\* (1974-1983)

	<u>Mar.-Oct.</u>	<u>Apr.-Oct.</u>	<u>May-Oct.</u>	<u>June-Oct.</u>	<u>July-Oct.</u>	<u>Aug.-Oct.</u>	<u>Sept.-Oct.</u>
H-L	251.32	251.27	244.1	229.07	192.92	136.75	97.72
$\sigma$	98.86	98.93	99.98	102.73	89.91	59.89	58.55

O-H or L	203.77	205.4	213.0	207.62	164.05	108.85	74.2
$\sigma$	84.56	88.91	92.5	101.87	106.88	57.59	53.14

\*H-L = Range from High price to Low price (in cents).

O-H or L = Range from opening price to the high or low, whichever is greater.

$\sigma$  = The standard deviation of the price range.

Table III  
The Straddle Ratios and Returns

1. May Contract

	<u>Price Range</u> <sup>a</sup>	<u>Straddle Price</u> <sup>b</sup>	<u>SR</u> <sup>c</sup>	<u>Return</u> <sup>d</sup>
November	65.43	73	.8963	.4127
December	54.73	58	.9436	.5194
January	46.99	42.5	1.1056	1.0241
February	40.03	42	.9531	.7173
March	29.13	26	1.1204	1.2245

2. November Contract

	<u>Price Range</u>	<u>Straddle Price</u>	<u>SR</u>	<u>Return</u>
March	119.21	59	2.0205	1.0781
April	116.49	58	2.0084	1.1356
May	120.50	51.5	2.3398	1.1939
June	105.75	50	2.1150	.7333

- a. Price ranges represent the minimum expected changes in soybean futures prices based upon the historical measure of  $\mu-\sigma$ , where  $\mu$  is the mean range of O-H or L and  $\sigma$  is its standard deviation (see Table II).
- b. Straddle price is the sum of call price and put price at the first trading date of each month.
- c. SR represents the straddle ratio which is the price range divided by the straddle price.
- d. This column represents the holding period return (gross) on the straddle from the date of purchase to the expiration of the option or in the case of the November contracts until the first of July when the study was completed. The straddle purchased in January was sold on the first of February when the SR became unfavorable.

Table IV

Comparison of the SR Strategy (showing buying signals)  
With the Call Alone and the Put Alone Strategies

	<u>Straddle</u>	<u>Call</u>	<u>Put</u>
<u>Jan.-Feb. (May Contract)</u>			
Return	1.0241	1.4878	.5714
$\sigma$ of Return	.0420	.1695	.1894
Sharpe's Index	24.38	8.78	3.02
<u>Mar.-Apr. (May Contract)</u>			
Return	1.2245	2.3077	.0109
$\sigma$ of Return	.1132	.141	.3373
Sharpe's Index	10.81	16.36	.03
<u>Mar.-July (Nov. Contract)</u>			
Return	1.0781	.2238	1.7576
$\sigma$ of Return	.0227	.1116	.0815
Sharpe's Index	47.49	2.00	21.56
<u>Apr.-July (Nov. Contract)</u>			
Return	1.1356	.1911	2.2745
$\sigma$ of Return	.024	.1197	.0805
Sharpe's Index	47.32	1.59	28.25
<u>May-July (Nov. Contract)</u>			
Return	1.1939	.1958	2.4681
$\sigma$ of Return	.0267	.1383	.08
Sharpe's Index	44.71	1.41	30.85
<u>June-July (Nov. Contract)</u>			
Return	.7333	.5833	.9655
$\sigma$ of Return	.0476	.1342	.1635
Sharpe's Index	15.4	4.3	5.9
Average Return of Six Buy Signals	1.0649	.8316	1.3412
$\sigma$ of Average Return	.1672	.8016	.8960
Sharpe's Index	6.54	1.04	1.49









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